Elastomeric Dampers Derived From First-Principles-Based Analytical Simulation, Phase I

Completed Technology Project (2008 - 2008)

Project Introduction

The lead-lag motions of rotor blades in a helicopter require damping to stabilize them. In practice, this has necessitated the use of external hydraulic dampers which suffer from a high maintenance cost. This high operational cost has prompted the rotorcraft industry to use elastomeric lead-lag dampers that result in ``dry'' rotors. However, complex behavior of elastomers provides challenges for the modeling of such devices, as has been noted by rotorcraft airframers. Analytical models have tended to oversimplify the complexity of the operational environment and make radical assumptions about operating parameters that, at best, lead to simple, and often unreal, device models. In spite of costly and time consuming experiments to construct them, these first order device models do not directly relate to neither material characteristics nor geometric configuration. Example: the device model approach leads to the erroneous identification of "physical phenomena" such as dual frequency effect. We propose a fundamentally radical approach wherein elastomeric dampers are derived from first-principle-based modeling rather than device model based analysis. First we propose to develop a finite element based simulation tool for modeling the response of complex components made of elastomeric materials. When integrated with a finite element based, multibody dynamics analysis code, this innovative tool will accurately simulate the dynamic response of vehicles such as rotorcraft using elastomeric components using true material properties and damper geometry. This tool will be unique because it will capture both dissipative and geometric nonlinearities causing damping loss at dual frequency excitations typically observed in elastomeric devices. When fully developed and validated, our first principles based formulation for the modeling of elastomeric devices will be available for robust component design.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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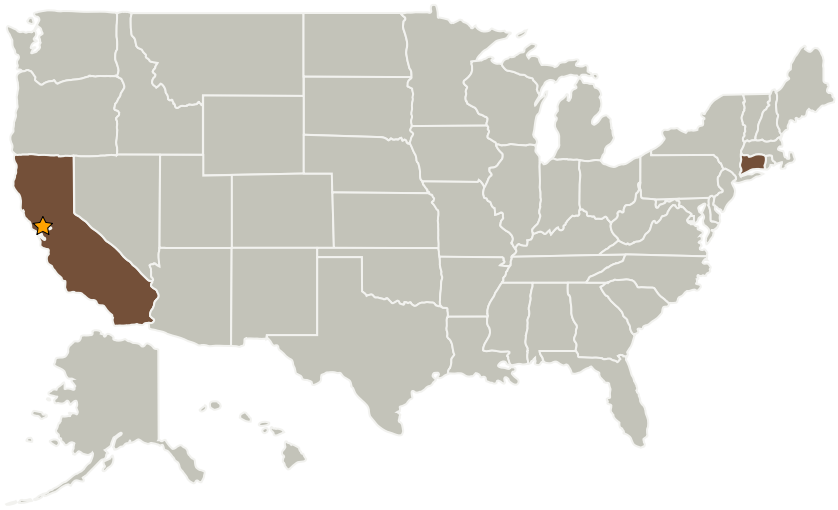
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
Materials Technologies Corporation	Supporting Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Monroe, Connecticut

Primary U.S. Work Locations	
California	Connecticut

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Serkan Ozbay

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL